

Polatzek also remarks that he noted some "as late as June." Apparently this must have been in another year.

Range. The Rock-Martin breeds in the Atlas Mountains and in the Mediterranean countries, and winters in north-east Africa. The extent of its winter range on the west coast of Africa seems to be little known.

[To be continued.]

XVII.—*Notes on the Height at which Birds migrate.*

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THE height at which birds migrate is one of the branches of ornithology upon which we are still profoundly ignorant. With the exception of one or two chance observations made through astronomical telescopes, until the advent of aeroplanes, our knowledge of the subject was limited to the range of human vision above the earth's surface.

W. E. D. Scott, of Princeton, U.S.A. (*cf.* 'Story of a Bird Lover,' New York, 1903), and F. M. Chapman (*cf.* Auk, 1888) were the first to publish authentic records of birds travelling at considerable elevations.

These naturalists detected birds flying across the moon's face while making telescopic observations of that luminary. Mr. Chapman's remarks are interesting: "During the first half-hour of observation (which lasted from 8 P.M. to 10.50 P.M., Sept. 3, 1887) a number of birds were seen flying upwards . . . these evidently being birds which had arisen in our immediate neighbourhood and were seeking the proper elevation at which to continue their flight; but after that time the line of flight was parallel to the earth's surface, the general direction being south." He was able to recognize Carolina Rails, Grackle, Snipe, and Duck. These he estimated crossed in front of the lens at elevations varying from 6000 ft. to 14,000 ft.

The height at which birds migrate is undoubtedly governed very largely by the meteorological conditions prevailing at the time, and when the air is inclined to be thick or heavily charged with moisture (if birds are migrating at all in such

weather) they will show a tendency to travel low—so low, in fact, that sometimes they almost skim the surface of the sea, as the writer has himself observed off the China coast.

In clear weather, on the other hand, the majority of birds will fly so high that even the largest of the day migrants passes unseen on its way to and from its summer quarters. Some species, however, appear to fly low habitually. Writing of the diurnal migration as noticed at the Tuskar Rock, Ireland, Prof. C. J. Patten estimates the average height for Meadow-Pipits to be 70 ft., for Wagtails 120 ft., and for Swallows 40 ft.

During the two years I was with the R.F.C. and Royal Air Force in France (1916–1918) I made every effort to collect information that would throw some light on the subject under discussion, and with this object in view I interrogated a very large number of pilots and observers—possibly as many as seven to eight hundred. The majority of these had seen no birds above a few hundred feet, but a small percentage had done so and were able to impart very interesting information, most of which I have endeavoured to incorporate in the present paper. Vague statements, or those open to question, have been omitted.

I have heard it said that the average man is too unobservant to make a mental note of birds encountered during the course of a flight. Under ordinary conditions there might be some ground for this argument, but it cannot apply in the present case. While on a patrol over the enemy's lines, vigilance was always of such vital importance that a pilot was extremely unlikely to overlook the passing of a flight of birds, and, moreover, an encounter of this kind was always regarded as an interesting event and one sufficiently unusual to warrant comment on return to the squadron, and generally an entry in the observer's diary.

For these reasons I think the data obtained can be regarded as tolerably reliable with regard to heights, dates, etc.; but unfortunately, as the majority of the observations were communicated by men making no pretensions to ornithological knowledge, the identification of the species, and sometimes the family, was not always certain.

The birds most frequently observed appear to have been Green Plover or Lapwings (*Vanellus vanellus*), and I have fourteen records of this species between 2000 ft. and 8500 ft., the majority being about 5000 ft. or 6000 ft. They were met with in flocks during the spring and autumn passage, the earliest dates being 1 February, 1918, and 15 July, 1917. On 26 February, 1917, Col. C. F. Portal, D.S.O., M.C., of No. 16 Squadron, encountered a flock of Green Plover at 6000 ft. over Candas. "These were flying at an air-speed of about 50 m.p.h. As they were heading more or less north, from which direction a very strong wind was blowing, their progress was almost negligible. At lower elevations the wind was more favourable, and had they chosen to fly close to the ground it would have been very nearly behind them. One wonders why they chose such an unfavourable current!"*

Geese and Duck have also been encountered on a number of occasions, and I have records of seven instances. Col. Portal met with birds of this family at a very considerable height, and has published the following note:—"While flying on duty between Béthune and La Bassée at a height of 8500 ft. this afternoon (26 November, 1915), I was astonished to see a flock of 500 Ducks or Geese passing over Béthune at least 3000 ft. above the level of our machine. The wind was about 45-50 m.p.h. N.N.E., and the birds were travelling due south."

The late Major MacCudden, V.C., informed me that he

* Normally the velocity of the wind increases rapidly as one rises above the earth's surface, and it is fairly safe to assume that its strength will be at least doubled within the first 1500 ft. At greater elevations the rate of increase is usually not so rapid. An east wind generally attains its maximum strength at 3000 ft., but winds from other directions may increase up to 30,000 ft.

The direction of the wind also changes very considerably as one ascends. It almost invariably veers, that is to say, alters in a clockwise direction, as one rises. It is quite usual for the wind to veer 40° or 50° in the first few thousand feet, and with an east wind (which is often comparatively shallow) there is frequently a complete reversal of direction, the flow of upper air being from the west instead of the east.

These important facts are generally overlooked by writers discussing the effect of wind upon bird migration,

had seen a flock of Geese flying over Abeele, Flanders, at 9000 ft., and I have two other notes of occurrences at 8000 ft. and over, and one as low as 3000 ft.

The greatest height of which I have a record is 15,000 ft. Lieut. J. S. Rissen, of 57 Squadron, met with "two large birds" at this elevation when flying a D.H. 4, in August 1917, over the country lying between St. Omer and the coast. Rissen informed me that he was certain of the height, and, from his description, I should say the birds were most probably Cranes. Col. Portal also met with a large bird which may possibly have been a Crane, but I will quote from his letter so that the reader may judge on this point for himself:—

"One day—April 21st, to be exact—my observer and I saw an enormous bird at 8000 ft. flying north over Lens. We were at 6500 ft., and there was a thin layer of mist just above us. My observer hit me on the back, and I looked up to see a very big bird, about 7 ft. or 8 ft. span, flying straight above in the opposite direction. My observer thought it was a Heron, but I think it was an Eagle. . . . The wing-flap looked like that of an Eagle, and I am sure it was a bird with a very short tail, large rounded wings, and greyish brown in colour. It might have been any size from 6 ft. to 16 ft. across, but I put it down as about 8 ft."

A propos of the above, I might mention that a pilot who had flown many hours on the Salonika front told me he had several times met with Eagles in that district at about 6000 ft., and it was in this region that the French aviator Louis Noël shot two Eagles in the air from his machine with a shot-gun.

Passerine birds do not, as a rule, appear to fly very high, but Major B. J. Silly, of 55 Squadron, and his observer Lt. A. P. Taylor saw some "Linnet-like birds, with dipping flight," at 10,000 ft. over Béthune on 22 August, 1917.

"About fifty Rooks, Jackdaws, or Crows" were noted over Lens at 6000 ft. in March 1917, and "six birds about the size of Rooks" flying S.W. over Arras at 3000 ft. on 10 July, 1918 (Major F. C. Russell). I have a record of Starlings at 3500 ft. and another of Fieldfares or Red-

wings at a similar height seen March 1917 (Lt. O. B. Wills, 34 Squadron).

My second highest record is of some "Sandpipers" observed by Capt. E. Pope, 57 Squadron, over Arras towards the end of March 1917. These birds, "about the size of a Snipe," were flying eastwards at an elevation of 12,000 ft.

Other birds, somewhat doubtfully identified but which were very probably Limicoline species, were seen by Major Russell of 32 Squadron at 10,000 ft., and by Lieut. King of 43 Squadron at 9500 ft., the latter on 18 December flying in a southerly direction.

Early in March 1918 Col. Portal saw a party of what I imagine to have been Whimbrel, since he describes them as being "exactly like Curlews, only about two-thirds their size." These were at 4000 ft., travelling very fast over Lens in a north-easterly direction.

Hérons have been met with by Lieut. O. B. Wills at 3000 ft., and by Capt. S. Stammers between 2500 ft. and 3000 ft. The latter, a single bird flying in a north-westerly direction, was over the Crouch, Essex, in September 1916.

In fine, still weather birds will often ascend to considerable heights for apparently no other reason than mere *joie de vivre*. During the mid-summer months, towards the heat of the day, Swifts, and possibly to a lesser extent some of the Swallows, make a practice of rising to the cooler strata of air, and I have often met with *Apus apus* in the mountains at several thousand feet, while in Trinidad I have noticed that the local forms of Swifts regularly disappeared from the lower levels as the sun gained force.

The four records I have of Swifts or Swallows (my informants were not able to differentiate between these species) at heights varying from 2500 ft. to 3000 ft. were probably attributable to this habit rather than to migratory movements. The same may also be said of the Gulls met with by Major Leather (88 Squadron) at 3500 ft. in Scotland during the spring of 1917, and of the large numbers of Wood-Pigeons seen by Col. Portal "circling round" at 1500 ft.